

## NOTES ON MEXICAN GRASSES V. TWO GYPSOPHILOUS SPECIES OF MUHLENBERGIA

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In the spring of 1962, Alan A. Beetle, of the University of Wyoming, sent us a number of specimens of *Muhlenbergia* for determination. Among them was a single plant collected in Nuevo Leon, Mexico, by A. Cuevas, agronomist at the Instituto Tecnológico in Monterrey. Although this grass differed in several respects from any species with which we were familiar, and appeared to be a novelty, we were reluctant to describe it from only a single specimen.

The following autumn, in connection with attendance at the Segundo Congreso Mexicano de Botánica, we were able to visit the locality from which the Cuevas plant had come. Along the edges of a sizeable barranca about 3 miles southeast of Galeana, we found a few plants which were similar to the original collection. These were growing in gypsum soil, and associated with *Bouteloua chasei*, a marked gypsophile. The area is, in fact, the type locality of this latter species. Searching in a number of other gypsiferous areas in the states of Coahuila, Nuevo Leon, and San Luis Potosí, we encountered our plant in two additional localities. Always it appeared to be relatively rare, and usually was growing on the sides of sink-holes, which are a characteristic feature of these gypsum flats. For an excellent description of the physical characteristics of gypsum flats, see Johnston (1941).

In late October of the following year we were again in Mexico. Returning to the area near Galeana, we found our "new species" to be rather abundant, and a quite conspicuous element of the grass flora there. It was also apparent that it is by no means confined to sink-holes, but may be scattered about amongst the common and dominant elements of these areas: *Bouteloua chasei* Swallen and *Muhlenbergia villiflora* Hitchc.

In one of their papers dealing with the ecology and vegetation of the state of San Luis Potosí, Rzedowski & Rzedowski (1957) discussed the plants new to the State. Unreported for San Luis Potosí at that time was *Bouteloua chasei*, which the Rzedowskis had found in several gypsiferous areas. They indicated (p. 203): ". . . otra gramínea a veces dominante es una especie al parecer aún no descrita de *Muhlenbergia*." Even though

we had never found our "new species" abundant enough in any area to be considered dominant, we reasoned that perhaps it was the grass to which they had referred. In a conversation with Rzedowski, however, we learned that his supposedly unknown *Muhlenbergia* had been determined later at *M. purpusii* Mez. This little known species was originally collected by Purpus (#5011) in 1910, near the Minas de San Rafael in the state of San Luis Potosí. Hitchcock (1935) states that it is "known only from the type collection."

Through the courtesy of T. R. Soderstrom, of the U. S. National Herbarium, we were able to examine a type fragment of *M. purpusii*, along with two other collections (*McVaugh* et al. 18204 and *Rzedowski s. n.*). These latter two specimens were gathered in essentially the same locality, some 36 miles south of Matehuala in the state of San Luis Potosí. Later, while visiting the New York Botanical Garden Herbarium, we encountered a complete isotype of this species amongst the *Muhlenbergia* "in-dets."

There seems little doubt that *M. purpusii* is the species most closely related to the plant originally collected near Galeana by Ing. Cuevas. The two differ in a number of respects, however, and these appear to be sufficiently great to justify their segregation as quite distinct species.

***Muhlenbergia gypsophila*** C. & J. Reeder, sp. nov. Gramen perenne circiter 35 (raro ad 50) cm altum; culmis caespitosis teretibus erectis, sub nodis et sub inflorescentia dense pubescentibus, ceterum glabris; vaginis scabris vel apicem versus breviter pubescentibus, quam internodi longioribus; ligula 2-3 (1.5-6) mm longa, membranacea firma, apice truncata et breviter ciliata, marginibus puberulentibus et plusminusve decurrentibus; laminae falcatis 2-10 (raro ad 25) cm longis, involutis, rigidis, supra breviter pubescentibus, subtus plerumque glabris et levibus sed raro cum spiculis paucis praebitis; panícula exserta confertiflora. plerumque 7.5-15 cm longa, contracta; ramis arte appressis, ad basin paniculae plerumque 20 mm vel minus longis, in parte superiore brevioribus gradatim, rhachi pedicellisque brevibus plusminusve dense pubescentibus; spiculis stramineis vel interdum leviter purpuratis, glumis subaequalibus acutis 1.5-2 mm longis, obscure 1-nervalibus, puberulentibus praecipue apicem versus; lemmate 3-nervali pubescente 3.5-4 mm longa aristata, arista flexuosa 10-15 mm longa ex apice lemmatis bifida; palea lemmati amplitudine paene aequali, 2-nervali, inter nervos pubescente, ceterum glabra; antheris pallido-luteis 1.5-2 mm longis; stigmatibus penicilliformis purpureis; caryopside late fusiforma fusca circiter 2 mm longa; numero chromosomae  $2n = 20$ .

Type: MEXICO: Nuevo Leon, 3 miles east of junction of Linares-Galeana road with Hwy. 85, gypsum flat with widely scattered shrubs and tree yuccas, occasional in depression along roadside, 6400 ft, 30 Oct 1964, J. R. & C. G. Reeder 3963 (holotype, YU: isotype, US).

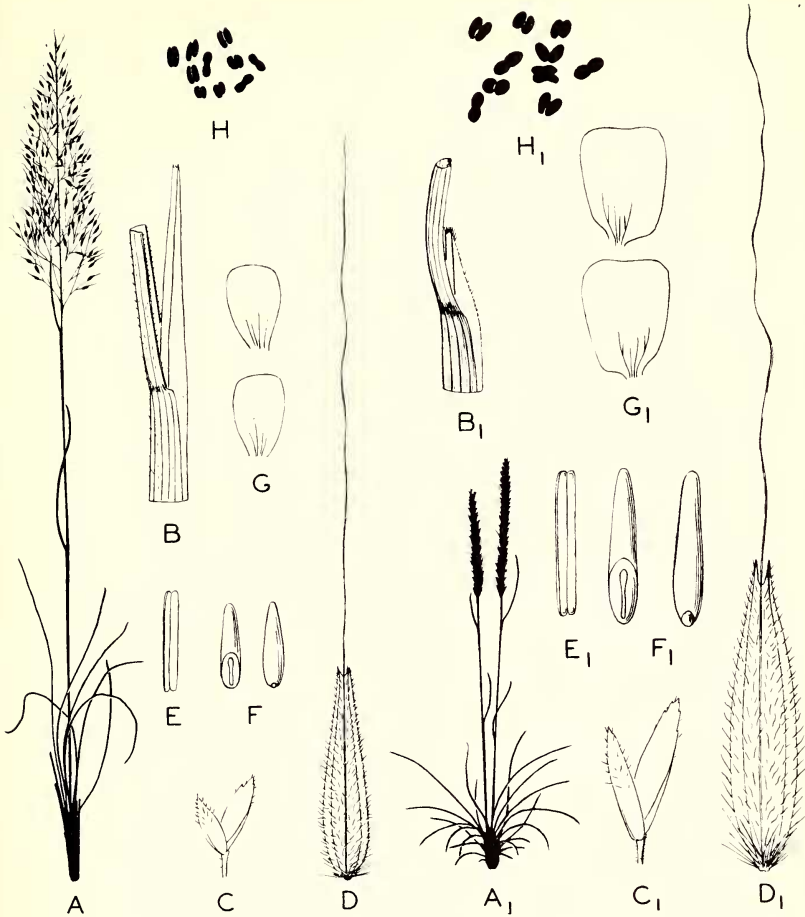


FIG. 1. Habit silhouettes and details of various structures. *Muhlenbergia purpusii* on the left; *M. gypsophila* on the right. A, A<sub>1</sub>, habit,  $\times$  ca.  $\frac{1}{6}$ ; B, B<sub>1</sub>, ligule,  $\times$  5; C, C<sub>1</sub>, glumes; D, D<sub>1</sub>, floret; E, E<sub>1</sub>, stamen; F, F<sub>1</sub>, caryopsis in two views (C-F<sub>1</sub>,  $\times$  10); G, G<sub>1</sub>, lodicules,  $\times$  50; H, H<sub>1</sub>, metaphase I of PMC division,  $\times$  900 ( $2n=20$ ). A-F from *Purpus* 5011; G & H from *J. & C. Reeder* 3669; A<sub>1</sub>-E<sub>1</sub> & G<sub>1</sub> from *J. & C. Reeder* 3963; F<sub>1</sub> from *Beetle* M-481; H<sub>1</sub> from *J. & C. Reeder* 3622.

#### Additional collections:

MEXICO: Coahuila, 35-36 mi S of Saltillo along road to Concepción del Oro, Zacatecas, 6200 ft, *J. R. & C. G. Reeder* 3622 (YU), 6000 ft, *J. R. & C. G. Reeder* 3987 (YU). Nuevo Leon: Galeana y cercanias, *A. Cuevas* 107 (YU), *Beetle* M-481 (US); 3-4 mi SE of Galeana, 5200 ft, *J. R. & C. G. Reeder* 3659 (YU); *J. R. & C. G. Reeder* 3965 (YU). San Luis Potosí: ca 12 mi NW of Matchuala on road to Cedral, 5500 ft, *J. R. & C. G. Reeder* 3668 (YU).

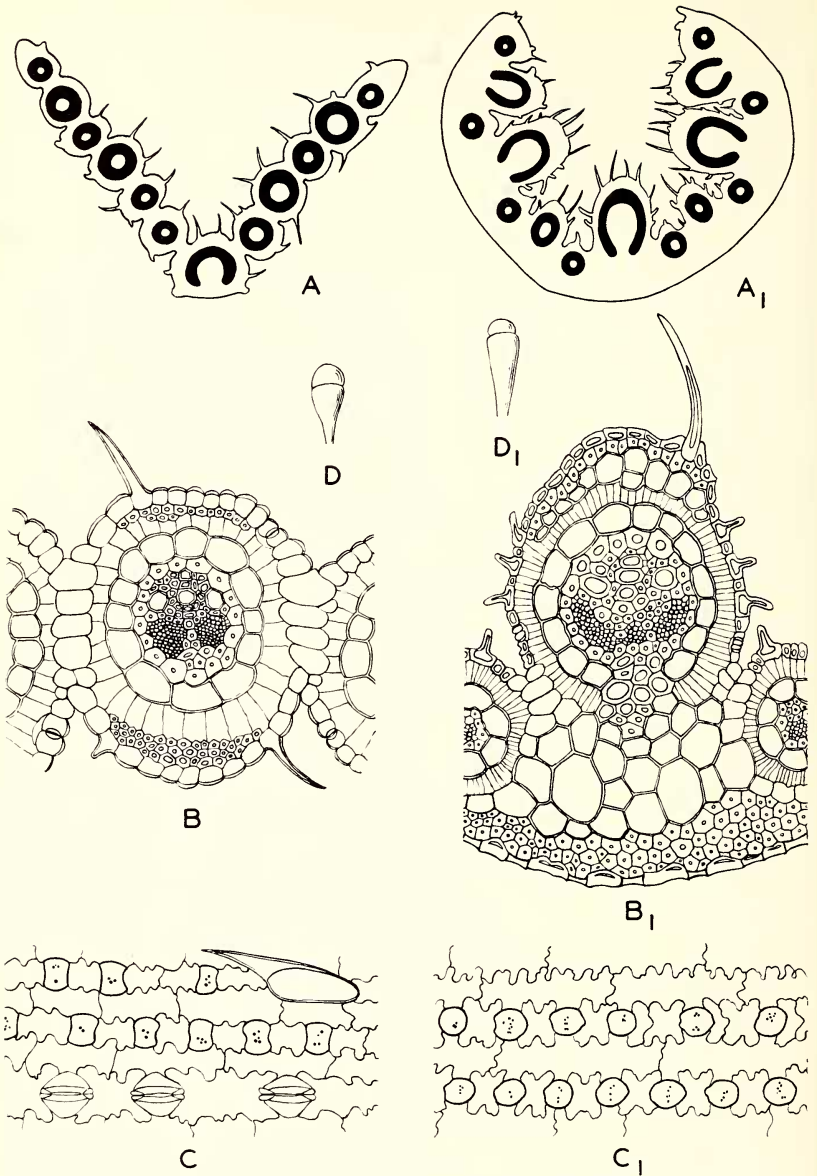


FIG. 2. Details of leaf anatomy and epidermis. *Muhlenbergia purpusii* (J. & C. Reeder 3669) on the left; *M. gypsophila* (J. & C. Reeder 3963) on the right. A, A<sub>1</sub>, diagram of transection of entire leaf blade,  $\times$  ca. 35 (the black areas represent parenchyma sheaths); B, B<sub>1</sub>, transection through region of a major vein, B,  $\times$  200; B<sub>1</sub>,  $\times$  150; C, C<sub>1</sub>, portion of epidermis from abaxial surface,  $\times$  225; D, D<sub>1</sub>, epidermal bicellular microhair,  $\times$  225. All drawings made from tracings of photomicrographs.

As indicated above, *M. gypsophila* appears to be related most closely to *M. purpusii*. These two species occupy similar habitats, and on one occasion we collected both in the same gypsum flat in San Luis Potosi. The most obvious difference between the two is that the new species is a somewhat smaller plant with a contracted spike-like panicle, whereas its ally is taller and the panicle is open. Both species have membranous ligules, but that of *M. gypsophila* is shorter and more firm. The leaf blades of the two appear somewhat alike but those of the new species are closely involute and essentially smooth on the abaxial surface, whereas in *M. purpusii* they are flat or folded and scabrous to hispidulous below. In spikelet morphology the two species are quite similar, but in *M. gypsophila* the glumes and florets are somewhat larger. This is true also in the case of lodicules, stamens, and caryopses (fig. 1).

Both species are diploid with a chromosome number of  $2n = 20$ , as determined from study of meiosis in pollen mother cells. It is noteworthy, however, that *M. gypsophila* has somewhat larger chromosomes (fig. 1, H & H<sub>1</sub>).

It has been noted already that the leaves of *M. gypsophila* are closely involute, whereas in *M. purpusii* they are flat or folded. More striking and important differences are revealed, however, when leaves of these two species are examined in transection. In those of *M. gypsophila* the lower epidermis is essentially smooth, whereas the upper surface bears numerous spines and papillae. The leaf has commonly 5 major bundles which are raised prominently above the remainder of the tissue. Two smaller bundles which are partially submerged occur one on either side of the midrib. Alternating with the units already mentioned are small bundles which are almost completely submerged in thick-walled parenchyma. Above the smooth lower epidermis is a layer of sclerenchyma 2 to 4 cells in thickness, and above this, thick-walled parenchyma which is in contact with the mesophyll. The major units show the familiar eragrostoid-chloridoid pattern, the bundle being surrounded by a double sheath, the inner of which consists of thick-walled sclerenchyma, and the outer of large parenchyma cells which contain chloroplasts. The parenchyma sheath is continuous in all except the 5 largest bundles. Outside this sheath, the cells of the mesophyll are arranged in a radial pattern. Bulliform cells in this leaf are rather poorly developed (fig. 2, A<sub>1</sub> & B<sub>1</sub>).

The contrast between the leaf described above and that of *M. purpusii* is striking. In the latter, spines and papillae are to be found in about equal numbers on both the upper and lower epidermis. It will be noted also that the units of the leaf differ only slightly in size, except for the larger midrib, and that they appear rather like the links of a chain. Each of these units is separated from its neighbors by a row of bulliform cells which extend from the upper to the lower epidermis. The bundles are of the typical eragrostoid-chloridoid type, as described above, but here the parenchyma sheath is continuous in all except the main vein. The radiat-

ing mesophyll extends to the bulliform cells on either side, and above and below is in contact with small patches of sclerenchyma which are just below the epidermis (fig. 2, A & B).

Not only the leaf transection, but also the epidermis is strikingly different in these two species. Both bear rather typical eragrostoid-chloridoid bicellular microhairs, but these have a different shape and arrangement. In those of *M. purpusii*, which are shorter in overall length, the apical cell is proportionately somewhat larger. They are found in the intercostal regions of both the upper and lower epidermis, where the stomata are also located. The numerous siliceous cells, which are in the costal region, are saddle-shaped (fig. 2, C & D). On the lower epidermis of *M. gypsophila*, which is essentially smooth, there are no stomata nor microhairs. The most striking feature is, perhaps, its uniformity, there being little or no difference between the costal and intercostal areas. The entire epidermis consists of essentially three types of cells — long cells, short cells, and siliceous cells. These latter which are abundant and rounded in outline, quite unlike those of *M. purpusii*, occur in rows of alternating short and siliceous cells. These are separated from similar series by one or two rows of elongated cells. The long and short cells both have very wavy margins. The upper epidermis, as mentioned previously, bears numerous spines and papillae. Stomata are frequent in the intercostal regions, and bicellular microhairs occur in these areas as well. Neither stomata nor microhairs are to be found elsewhere on the leaves of this species (fig. 2, C<sub>1</sub> & D<sub>1</sub>).

To encounter such striking differences in the leaf anatomy and epidermis of presumably closely related species is certainly not to be expected. Perhaps the relationship here is, in fact, rather remote. The similarities in gross morphology may reflect parallelism or convergence rather than close genetic affinity.

MUHLENBERGIA PURPUSII Mez, in Repert. Sp. Nov. 17: 214. 1921.

Specimens examined: MEXICO. San Luis Potosí: Minas de San Rafael, Nov. 1910, *Purpus* 5011 (US, Type fragment; NY, isotype). Near the Minas de San Rafael in the Sierra de Guadalcázar, 1900–2100 m, *Sohns* 1515 (US, YU); 3 mi E of junction of Guadalcázar road and Hwy. 57, 5500 ft, *J. R. & C. G. Reeder* 4075 (YU); Near Km 549, 36 mi S of Matehuala, 1250 m, *McVaugh, Loveland & Phippen* 18204 (ENCB, US); Km 556, Carretera México-Piedras Negras, 1400 m, *Rzedowski s.n.* (US); San José del Refugio, carretera central, Km 550, *Medellin L. 1130* (ENCB, SLP, YU); 12 mi NW of Matehuala on road to Cedral, 5500 ft, *J. R. & C. G. Reeder* 3669 (YU); 4 km al norte de Rioverde, sobre el camino a Pastora, 1000 m, *Rzedowski* 9574 (ENCB, SLP, YU).

Although *M. gypsophila* and *M. purpusii* occupy similar habitats, their ranges appear to be rather distinct. The new species has been collected in the states of Coahuila, Nuevo Leon, and northern San Luis Potosí. In the last locality it was found growing with *M. purpusii* and this is, indeed, the only area in which we have found these two species associated. All collections of *M. purpusii*, of which we are aware, have come from the

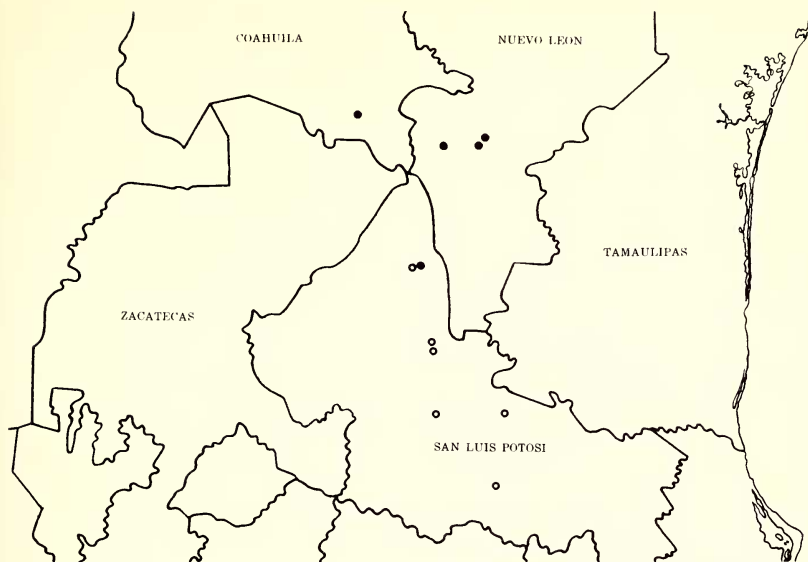


FIG. 3. Map showing the range of *Muhlenbergia gypsophila* (closed circles) and *M. purpusii* (open circles).

state of San Luis Potosí. The ranges of the two species, as far as we have been able to determine them, are shown on the map (fig. 3).

In his comprehensive thesis on the "Vegetación del Estado de San Luis Potosí," Rzedowski (1961) describes the gypsiferous areas in some detail. He refers to the vegetation of these habitats as "zacatal ralo," indicating that only about 30 per cent of the soil is occupied by plants, the dominant elements of which form circular colonies with bare centers [fairy-rings]. *Bouteloua chasei* and *M. purpusii* are given as the dominant grass species. In Fig. 26 of the publication cited above, which is a photograph of one of these habitats near Vallejo, the "fairy-rings" are clearly shown.

Rzedowski's description of the habitat applies well to most of the areas in which we have encountered both *M. purpusii* and *M. gypsophila*. Except for the region near Vallejo, however, in the areas in which we have observed *M. purpusii* it has not appeared to be a dominant element. For the most part, we have found it as scattered clumps amongst *Bouteloua chasei* and *M. villiflora* which in our experience are usually the dominants in these gypsum flats.

#### SUMMARY

*Muhlenbergia gypsophila*, a species apparently restricted to gypsum soils of north central Mexico, is described as new. It is compared with its presumed closest ally, *M. purpusii* Mez, a poorly known Mexican

endemic. Although both species are diploid ( $2n = 20$ ) and occupy similar habitats, detailed studies of the leaf anatomy and epidermis reveal striking differences between these two grasses. A range map showing the known collecting sites for both species is provided.

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#### NOTES AND NEWS

*Selenium, Geobotany, Biochemistry, Toxicity and Nutrition*. By IRENE ROSENFELD and ORVILLE A. BEATH. xii + 411 pp. Academic Press, New York. 1964. \$15.00.

*Wild Flowers in South Carolina*. By WADE T. BATSON. vi + 146 pp. University of South Carolina Press, Columbia. 1964. This is an attractive, popular book with glossary, keys, descriptions, and colored photographs of the more common woody and herbaceous flowering plants of South Carolina.

*Great Smoky Mountains Wildflowers*. By CARLOS C. CAMPBELL, WILLIAM F. HUTSON, HERSHAL L. MACON, and AARON J. SHARP. 88 pp. University of Tennessee Press, Knoxville. Enlarged edition. 1964. \$1.50. This spiral-bound booklet contains very good colored photographs and notes on about 125 kinds of flowering plants of the Great Smoky Mountains.

*Trees, Shrubs, and Woody Vines of Great Smoky Mountains National Park*. By ARTHUR STUPKA. x + 186 pp. University of Tennessee Press, Knoxville. 1964.

*Algae and Man*. Edited by DANIEL F. JACKSON. x + 434 pp. Plenum Press, New York. 1964. \$14.50.

*Aquatic Plants of the Pacific Northwest with Vegetative Keys*. By A. N. STEWARD, LA REA J. DENNIS, and HELEN M. GILKEY. Oregon State Monographs, Studies in Botany No. 11. x + 261 pp. Oregon State University Press, Corvallis. Second edition. 1963. \$4.50.

*The Developmental Anatomy of Isoetes*. By DOMINICK J. PAOLILLO, JR. Illinois Biological Monographs No. 31. vi + 130 pp. University of Illinois Press, Urbana. 1963.

*A Journal of Explorations Northward along the Coast from Monterey in the Year 1775*. By FATHER MIGUEL DE LA CAMPA. Edited by JOHN GALVIN. 67 pp. John Howell Books, 434 Post St., San Francisco. 1964. \$7.50.

*Journal of José Longinos Martínez, Notes and Observations of the Botanical Expedition in Old and New California and the South Coast 1791-1792*. Translated and edited by LESLEY BYRD SIMPSON. xviii + 114 pp. John Howell Books, 434 Post Street, San Francisco. 1961.

*The Oregon Desert*. By E. R. JACKSON and R. A. LONG. xvi + 407 pp. The Caxton Printers, Ltd., Caldwell, Idaho. 1964. \$6.50. Although primarily historical, this book contains considerable information about the natural history of the arid part of Oregon. In particular there are two chapters, *The Desert-Wise Plants and Grass Grows by Inches—It is Destroyed by Feet*, dealing with the vegetation of the region.